Design for Manufacturing & Assembly: New Product Introduction

Developing a total ‘Lean Enterprise’ by focussing on Design for Manufacture and New Product Introduction

Steve Boam, Managing Director, Knowledge, Management & Transfer (KM&T) Group

SYNOPSIS:
One key areas of Lean Thinking that is regularly overlooked is the Concept, Design, Development and Launch readiness phases. This is probably due to the fact that only a handful of Lean Specialists outside of Toyota have the training, knowledge and experience to coach and mentor in this field.

Businesses now realise that savings and performance improvements can be made at the Production or Process end of the business. In many cases this has been the correct area in which to start a Lean deployment as it is closest and most critical to the customer. Few businesses have looked upstream to the front end of the Process to realise that perfecting the design, development and launch phases eliminates waste and the need to rectify mistakes during launch, building in a Total Cost and a Quality approach. Considerable savings in cost, effort and most importantly Lead time to market are benefits some businesses are now realising by focussing at the front end and following through to production.

Also if not considered, these initial phases of the total process ‘Concept to Launch and Steady State’ can contribute to current and previous savings and/or improvements being lost or overwritten when a new product is introduced.

This article focuses on the unknown and overlooked areas of Lean and some of the critical concepts applicable from day 1 of an NPI (New Product Introduction) process.

INTRODUCTION:
The growing global interest across business sectors in Lean Manufacturing, Thinking, Tools and Techniques, makes it both a fascinating and rewarding area in which to provide expertise and guidance. Many companies from Large OEMs to Small SMEs have already adopted Lean Principles from the now world famous Toyota Production System (TPS) and have attempted to apply them to their own businesses with varying levels of success.

Those companies who have recognised the greatest benefits from Lean, are those who have learned to look within, and realised that not all Lean Tools apply to their business and those that do, will potentially require some level of modification. Anyone can read from the plethora of Lean books currently available, but few are able to co-ordinate a successful implementation and sustain the benefits, whilst continuously looking for the next improvement on a daily basis.

Lean Thinking (incorporating Manufacturing, Service, Office, Public and Other Sectors) is fast becoming a World Class business model, supporting businesses to operate more effectively, with stability, control and efficiency. Lean has been responsible for making significant improvements to performance and output.

Lean Thinking is now being adopted not only in the Operations Area but company wide, as a way of managing a business. Companies who have successfully implemented Lean on the shop floor are now beginning to realise that it is key to involve all areas to achieve business success, including all of the supporting functions, both direct and indirect areas including the supply chain. Focus should also be directed towards customers needs (VOC – Voice Of the Customer), ensuring processes are designed, supported and geared towards achieving and exceeding customer expectations.

An effective approach and method of improving performance, flexibility and agility is to use Lean Thinking, which should be considered and tailored in line with the business location, culture, product or service provided and customer base. Lean results in greater stability and control by managing the business more effectively. This allows companies to easily adapt and change or become agile, it should also support the achievement of all plans, targets and business vision.

THE TOYOTA APPROACH:
Lean Manufacturing is a western term for the adoption of tools and techniques developed by Toyota Motor Corporation. The Toyota
Production System (known as TPS) was formally developed in the early 1950’s and is a live, continually evolving system, which has taken Toyota from an unknown manufacturer to one of, if not the most successful of manufacturing and corporate businesses.

Toyota’s approach is unlike any other. By developing a simple business model that is understood by all employees and a standardised set of tools, Toyota have empowered their workforce to own the local areas, processes and tools enabling detailed management and control to promote flexibility and performance.

Toyota continue to exceed all market expectations and now generate profits far greater than any competitor in any manufacturing sector.

**LEAN FOR BUSINESS:**

The success of a lean implementation, project or programme, is reliant upon direction from senior management, and the involvement and ownership of everyone within the organisation.

The key to Lean is ‘Simplicity’, working with operators to identify and standardise the current state, we can identify, analyse and simply ask questions on how to improve.

The most effective approach is to adapt the tools and techniques to fit the business, not try to adapt the business to fit the tools. This will promote flexibility, empowerment, enhancing our current methods and creating substantial long term benefits.

A Lean Enterprise is one that uses Lean in all areas to develop stability and flexibility to meet and satisfy customer demand.

To survive on a global playing field, it is essential that companies offer all of the following:

- Flexibility
- Value
- Innovation
- Competitive advantage

Only true Lean Enterprises will survive, taking advantage of the challenging times ahead.

**LEAN ENTERPRISE:**

Lean Principles (installed correctly) ensure that the product will be easier to build, with parts delivered in the correct manner and at the right price, whilst reducing the total cost and lead time taken to get products from concept through to launch. It will in short ensure people and processes are adding Value to the product.

An output is how flexible a business can become, once a stable and easily maintainable operating system is established. A truly Lean Business is one that is run as a Lean Enterprise and can adapt at short notice, in a planned and controlled manner, to continue to meet the demands of its customer or market.

It also supports a strategy for breaking into new markets, by utilising and benefiting from local expertise, resource, and economic advantages. Toyota have used this approach to take their business operating system (TPS) and learning out of Japan to nearly all continents.

**ARE THE RIGHT AREAS BEING CONCENTRATED ON?**

Studies suggest that traditional businesses can benefit from savings in cost by focussing efforts on improving operations and processes closest to the customer. It is also proven that if we plan ahead and focus our efforts at the front end of the process and look at our product development cycle and approach, we can actually create considerably greater benefits and savings in terms of lead time reduction, quality and cost performance. Studies show that up to five times the savings currently realised in operations can be achieved by focusing on the process stages at the start of the product lifecycle – Research, Development & Design.

Traditionally these departments operate with a silo mentality and are removed from the day to day operational issues. However they are seen as high cost areas that add value to the organisation. These areas are usually deemed as untouchable with regard to process change and external interference.

It is no longer acceptable to create products that are just desirable through style and innovation. Safety, Quality and Value are now customer requirements in most market places.

It is therefore a huge commitment and leap of faith for any business to spend time, effort and resource on changing the front end processes, knowing that the benefits may be months or years away from being recognised and counted on the balance sheet.
CONCEPT THROUGH TO LAUNCH

Traditional businesses do not always follow a clear and structured process for all stages, from first ideas through to generating a concept for approval, engineering and development through to launch. Generally we can clearly see several stages which often overlap and become confusing with many or all departments involved at the wrong times.

In many companies, a new concept or drawing is never actually finalised even during the launch stages, ramp-up and sometimes into production. This leads to fire fighting, in-efficiency and confusion. Creating missed delivery deadlines and poor quality, adding unwanted pressure to the operations areas to resolve the issues. A worst case scenario is where the above reaches the customer base, resulting in warranty, rework and customer dissatisfaction.

TRADITIONAL PROCESS AND PROBLEMS:

Lean Product Design

In a Lean Enterprise there is a controlled and effective way of managing all phases from Concept through to Launch. This is done by standardisation and introducing clearly defined phases. We are looking as with any Lean tool, to only manage the exceptions and to escalate and react when things deviate from the norm or standard. This way of life allows us to manage our business effectively and to catch back before it’s too late, avoiding launch delays or disruption.

By devoting time and effort at the early stages we can design in success and design out concerns, issues, problems and cost. Traditional approaches find and raise most concerns after the launch point as volumes increase and all variants are seen for the first time. This again puts pressure on the business at a critical time.

Adding more stages into a shorter timescale?

Businesses need to add more confirmation cycles into the existing phased approach, but at the same time reducing the total timescale to market. This is a challenge for even the best companies. Two very powerful philosophies, DFMA (Design for Manufacture and Assembly) and NPI (New Product Introduction), can be used within Lean. Both focus efforts on delivery and performance for the internal and external customer.
DFMA (DESIGN FOR MANUFACTURE & ASSEMBLY)

DFMA is fast becoming a valued phase of the total process. Using a Lead Member or Team who has extensive experience of the current business, processes, tools, equipment, ideals and techniques, it is possible for a structured DFMA activity to be conducted.

Results are an improved product and supporting processes, developed at the earliest time whilst minimising cost.

DFMA focuses on designing the following into a business:
- Product Cost Reduction (rationalisation, parts reduction, one touch manufacture)
- Product Build Capability
- Reduced Complexity (variation) – Note: without compromising the product
- Process Design
- Process Efficiency
- Product Quality/Process Capability
- Ergonomics & Process Design
- Poke Yokes (Error Proofs)
- Product Test & Serviceability
- Elimination or reduction of rework (RFT – Right First Time)
- Elimination of Customer Complaints (Warranty)
- Make or Buy Strategy – Purchasing
- Design in Performance and Measures

A key part of DFMA is to review the current state to ensure the carry over of all the positives (design, parts, process, tooling, equipment), and to design, and engineer out any of the current negatives.

Using DFMA can achieve total cost reductions, and also engineer fixes and improvements (safety, quality, delivery) into products and processes.

DA – DIGITAL ASSEMBLY

A very powerful tool now being developed and used is Digital Assembly or Virtual Modelling. By converting 2D drawings into 3D images, components, total assemblies, tooling, equipment, process design and work areas can be simulated and assessed.

This tool reduces the need to create expensive mock-ups of parts and allows fitting method, part clearances, tolerance studies, process interference and repeatability checks to be assessed before any firm commitments and drawings or tools have been produced. By using tools like DA significant development time and cost can be eliminated from the NPI total programme.

NPI (NEW PRODUCT INTRODUCTION)

A standardised NPI system brings together Design, Development and Production Operations to form a directed, cohesive team with common objectives. It enables a new product to be brought on stream effectively and efficiently, satisfying design intent. Early input and involvement is key to the success of any project.

Elements captured within an NPI system include:
- Structured Project Management
- Safety, Quality & Delivery Focus
- Design Tolerance / Accuracy
- Customer / Sales input – Production Planning
- Design strategy – Quality & Function
- External supplier involvement
- Manufacture Strategy & Assembly Strategy
- Ramp-up planning
- Standardised handover at each stage
- Concern Elimination

One of the most crucial parts of the whole process is the launch period. The target must always be to minimise lost production, change over and ramp-up as quickly and effectively as possible. This is achieved by implementing a stepped approach.
SUMMARY:

Hopefully this article has demonstrated the emerging elements of Lean Thinking. It is no longer acceptable to focus solely on the Operations Areas. The traditional departments responsible for the front processes, operating with a silo mentality need to be considered and changed. Aligning their efforts and input to the end goal of launching a product into the market place that is desirable through style and innovation and meets the Safety and Quality standards and offers Value for Money, all of which are now the expected norm with regard to customer expectations.

Only true Lean Enterprises will lead the way in industry in the near future. In order to maintain and remain competitive in an increasing Global Market, businesses should understand and learn from companies practicing Lean, DFMA and NPI.

Lean tools have been proven as the most effective method for offering total control and performance management. The key is to select the right tools for your business, modifying them where necessary to meet your product/organisational requirements. The Lean Toolbox is vast but not prescriptive. It is not about ticking the boxes.

Toyota are one of the most successful businesses in history, on a truly Global scale. They continue to drive forward by selecting and continuing to evolve the business model, tools and techniques, without re-inventing the simple but powerful production methodology TPS.

They have been able to drive change and continuously improve and are now benefiting from the hard work and establishment of effective processes in Production, Support areas, Design and Development. They have made advances in the last few years by focussing on their approach and involvement in DFMA and NPI. Toyota have been able to launch vehicles faster and smarter, with outstanding cost and quality results, building on their brand image. They have demonstrated that they are the benchmark example of a Lean enterprise and have clearly defined goals and strategy to be the Worlds No1 Car Manufacturer and Assembler.

Figure 11

Lean Enterprise Model

Toyota (‘Masters of Lean Enterprise’) have used their TPS Lean Business Model to drive improvements in a controlled and logical manner on a global scale.

About the author

Steve Boam, Managing Director, Knowledge, Management & Transfer (KM&T) Group.

Steve is an experienced Lean Specialist working in all industry sectors to implement sustainable and robust tools and techniques to deliver business improvements. Steve is highly knowledgeable, experienced and enthusiastic about Lean and the benefits of Lean Thinking.

Steve’s major projects have included Automotive, Aerospace, Agricultural, Marine, Supply Chain, Office and Service Projects, supporting clients to make significant improvements to Quality, Cost, Delivery and the bottom line KPI metrics.

Prior to consultancy Steve was Lead Engineer for the Corolla model working for Toyota in the UK and Toyota Motor Corporation in Japan. Responsibility was for controlling all project aspects from design & development to facility preparation, training and launch management.

Having worked on initiatives at Toyota including the above topics, Steve is pleased to see other companies and institutes start to gain interest and look at their front end processes to see how they can drive towards being a Lean Enterprise.

KM&T are a leading ‘Lean Consultancy’ employing ex-Toyota trained specialists to drive change into new and exciting areas, supporting clients to make significant gains in business performance.